ON THE EDGE

A Guide to Managing Land for Bobwhite Quail

Acknowledgement
Foremost we are indebted to the Virginia Department of Game and Inland Fisheries, particularly to Steve Capel and Irv Kenyon, for allowing us to use material published in "Beyond The Food Patch: A Guide To Providing Quail Habitat." We are grateful to the numerous contributions by Missouri researchers Jeff Janvrin, Ernie Wiggers, Wes Burger, Mark Ryan, Eric Kurzejeski, Ron Drobney, John Schulz, Steve Sheriff, Craig Scroggins, Eileen Dowd, Rich Cannon, Elena Seon, Brian Root, Tina Vangilder, Leslie Burger, Vicki Heidy, Eliodora Chamberlain, Ted Seiler, Jim Savage, John Lewis, Jack and Jean Stanford, Clifford Caldwell, LeRoy Korschgen, Ned Gruenhagen and Erynn Call.

Compiled and written by Tom Dailey and Tom Hutton
Typeset by Jean McKinley
Edited by Tom Hutton and Joan McKee
Designed by Ara Clark
Front and back cover by Mark Raithel

Contents

Where Have All the Quail Gone?

Quail are a non-migratory species that thrive where shrubs and trees meet grassland, cropland and weedy areas. The persistence of quail populations, like those of other small animals, depends on abundant reproduction to replace the many birds that die of natural causes. Besides the usual hawks, owls, foxes, weasels, raccoons and snakes, bobwhite can run afoul of blizzards, hailstorms, floods, heavy rain, drought, fires, pesticides, mowing machines, collisions with vehicles and buildings, and trampling by livestock. Bobwhite, however, can breed back almost from the edge of oblivion. Through thousands of years of predation and bad weather, quail have persisted. All these birds need to flourish is mild weather and suitable habitat.

Missouri, unfortunately, begins this century with the bobwhite in big trouble. One of the most vexing questions facing biologists, quail hunters and bird fanciers in most of the bobwhite's range in the eastern United States is the apparent disappearance of quail. In Missouri, quail abundance and quail hunting have fallen to record lows. So, where have all the quail gone?

Cutting timber, burning, disturbing the soil, renewing vegetative succession are the activities to which quail responded favorably in the past. Producing quail habitat today demands the same approaches, which include:

- creating and maintaining some acreage in the fallow and old field stages
- actively managing for quail on existing idle lands
- addressing the needs of quail when cropping and grazing
- conducting quail-friendly timber management
- avoiding cosmetic mowing of brush, weeds and native grasses
- encouraging neighbors to join in the effort.

Providing bobwhite quail habitat takes time, money and acreage. Success will require perseverance and patience, as quail management never ceases to be a work in progress. Those who want to share their properties with bobwhite quail must acknowledge its absolute need—habitat—and continue to apply the management techniques that will achieve that goal.

Those who want to share their properties with bobwhite quail must acknowledge its absolute need—habitat—and continue to apply the management techniques that will achieve that goal.

The answer is not simple, and quick-fix remedies will have little, if any, long-term, benefit. Quail can thrive again in Missouri with effort and cooperation among landowners, farmers, hunters, Missouri Department of Natural Resources, Soil and Water Conservation Districts, U.S. Department of Agriculture, federal land management agencies, bird-hunting and conservation groups, and the Missouri Department of Conservation.

This booklet provides knowledge of bobwhite life processes, population dynamics, habitat needs, popular management issues and myths, as well as steps that can be taken to help the land produce quail. If more help is needed, see page 63 to contact Conservation Department staff in your area.

History of Quail in Missouri

Quail evolved on the edges of Missouri's prairies and on Ozark glades and savannas, where they found:

- grass for nesting and winter roosting
- seeds from native weeds, legumes and wildflowers, and insects to eat
- fruits and cover from shrubby draws
- acorns, pine nuts, other seeds and winter shelter from savannas and oak/pine woodlands.

Elk, bison, wildfires, tornados, floods and periodic droughts were major factors that created conditions conducive for quail. Bobwhite numbers naturally fluctuated dramatically, with numbers increasing in areas where quail habitat was being recreated by these forces.

EUROPEAN SETTLERS CREATE ABUNDANT QUAIL HABITAT

Europeans who settled Missouri brought vast changes to the landscape and to the creatures that lived on it. In the early 19th century, they started a cycle that greatly benefited quail. The settlers cleared the forest and broke the thick prairie sod. Their crop fields and bluegrass pastures were small, surrounded by split-rail fences and Osage-orange hedgerows where annual weeds and brush flourished. These settlers created vast new areas of edge, and there quail flourished.

> *Shelby County, Missouri, 1844: "Jan. 10th, Went Partridge hunting–caught 77; Jan. 11th, caught 41; Jan. 12th, Partridge hunting again–caught 91; Jan 22nd, Went Partridge hunting–caught 103. Caught 28 at one drive. I have wasted several days hunting partridges lately, but I think I will not waste much more time."*
> *—Alexander Slayback*

So went the bobwhite quail hunting season of Alexander Slayback, an attorney in northeast Missouri. As was the custom of the day, Slayback, along with a hunting companion or two, on horseback herded the quail into walk-in nets. Such large catches of quail, or partridges as they were often called, were common across the Midwest and made bobwhite popular for commercial trapping and shipment to East Coast markets. Records from Wisconsin and Nebraska in the 1800s show indi-

Left: *Farming relatively small fields once created ideal quail habitat in Missouri.*
Below: *Cropping practices before 1970 also contributed important elements of good quail habitat.*

Above: *Large fields, common in modern farming operations, lack many quail needs.*

vidual shipments of 55,000 and 18,700 quail, respectively, totalling nearly 12 tons. This era of extreme exploitation did not last long. By the turn of the century, a scarcity of quail greatly reduced or eliminated hunting in many places in the Midwest.

THE 20TH CENTURY: BOOM AND BUST

Biologists estimate there were about 1.7 million quail statewide at the end of the 1800s. In the 1900s, Missouri witnessed the best and worst of quail abundance and hunting. In the absence of plentiful deer and turkey populations in the first half of the century, most Missouri hunters pursued small game. Rabbits, quail and squirrels were abundant and easily accessible. By the late 1960s quail populations and hunter numbers soared. The greatest number of days afield by quail hunters was 1.2 million in 1970 and 1971. During the better years, hunters bagged more than two quail a day on average. The highest daily bag was 3.2 in 1969. The hunters' passion was fueled by an abundance of quail.

Although biologists cannot accurately estimate quail numbers on a statewide basis, there were likely around 13 million during the heyday of quail hunting in the late 1960s. During the last half of the 20th century, the Missouri Department of Conservation's hunter and quail surveys documented the roller-coaster nature of quail life. As the century came to a close, the surveys also showed a seemingly permanent, long-term downward trend. *See chart below.*

Quail once were a by-product of agriculture, but intensive farming practices increasingly leave less habitat.

EXPERTS WARN THAT QUAIL ARE HEADED FOR TROUBLE

Quail once were a by-product of agriculture, but land-use changes increasingly leave little for them. Biologists identified three main threats:

1) intensive use of land for crop production and cattle grazing
2) loss of land to a growing human population
3) loss of brushy cover to natural successional growth toward trees and forests.

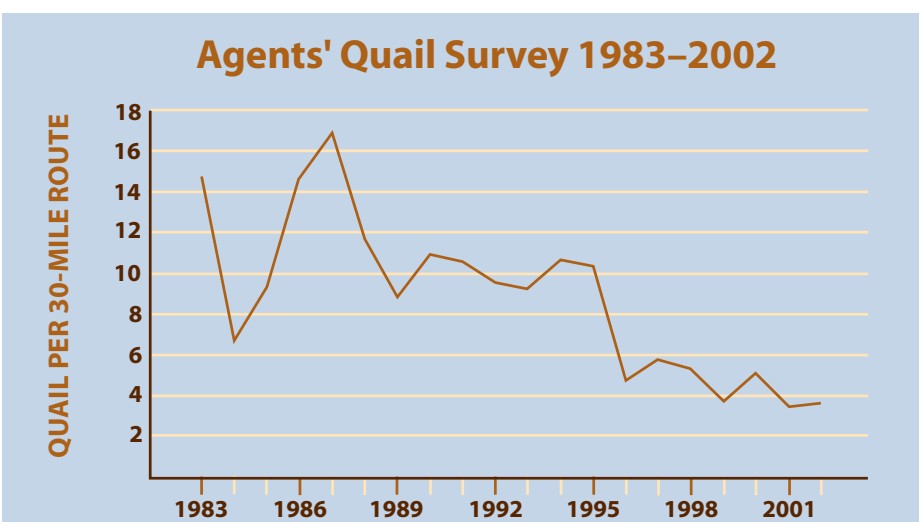
Quail researchers recognized that pressures to produce more food with fewer costs would reduce quail habitat. Missouri's long-time quail expert, Jack Stanford, crisscrossed the state in the late 1960s and early 1970s educating Missouri landowners and hunters about these habitat changes and their effect on quail and other wildlife.

Intensive agriculture takes toll

As agriculture evolved in the 20th century, Missouri's landscape began to change dramatically. To be profitable, farming had to become increasingly efficient. Small fields gave way to larger ones as thousands of acres of brushy woods, draws and hedgerows disappeared to become extra rows of corn or soybeans or fescue pasture. Without these woody covey headquarters where the birds rest and find shelter from the elements and predators, quail simply cannot survive.

Many modern croplands are inadequate quail habitat in other ways, too.

Chart Below: *Declining quail population over the last 20 years are the result of the deterioration of quail habitat.*



Widespread use of pesticides has indirectly hurt quail by eliminating most weeds. Further, traditional crop rotations of corn, soybeans and wheat oversown with lespedeza or clover have given way to less diverse corn/soybean combinations, as well as double-cropping soybeans after winter wheat is harvested. The net effect of these changes is less food and cover for quail.

Farmers began to use Missouri's grasslands, pastures and hay fields more intensively, in many cases heavily grazing forests, woodlots and hedgerows in the process. Also detrimental to quail was the replacement of annual lespedezas, bluegrass and native grasses by tall fescue. As a result of the loss of quail-friendly pasture plants, vast areas of land have become less hospitable to quail.

Above: *Intense use of fescue pastures leaves little food or cover for quail.*
Below: *Urban sprawl permanently eliminates quail habitat.*

Trees replace brushy cover

By clearing forests, pioneer farmers created the thick, low-growing, woody cover for escape and protection from the elements that quail need. Over the decades, trees replaced the brushy, woody cover through natural processes. In addition, Missouri's growing deer herd has further reduced this essential brushy understory.

Cliff White

Urban sprawl eliminates quail habitat

When people move from cities to the country, they create more roads, highways, golf courses and other landscape changes that have diminished quail habitat. Today as more people are moving to small acreages, they bring suburban landscaping ideas with them. As a result, quail suffer from large stretches of well-manicured lawns and clean fencerows.

20TH CENTURY TINKERING

At various times since the birth of the Missouri Department of Conservation in 1937, desperate

Above: *Quail can't flourish in large areas of undisturbed mature forest.*

quail hunters, agency personnel and entrepreneurs have sought to provide a more abundant and consistent crop of game birds. In mid-century, biologists attempted controlling quail predators and releasing pen-raised quail with the intention of boosting quail populations.

By the turn of the 21st century, all state natural resource agencies had discontinued these practices because they weren't economical and didn't permanently increase quail populations. For more information on why these practices don't work, see page 53.

QUAIL'S FUTURE IS IN LANDOWNERS' HANDS

We begin the 21st century with the reality that quail will not thrive unless we manipulate land in their behalf. Without such effort, quail will exist at low levels in most places and disappear altogether in some areas. The greatest challenge is to learn the art of quail management, which is based on scientific knowledge and refined through experience.

The following chapters are designed to help quail enthusiasts who want to produce a thriving quail population. For further information or assistance with your land, call the Conservation Department staff in your area. See page 63.

Trees can be a natural enemy of quail, and only through human intervention can Missouri's woody habitat be held in top condition for quail.

Quail are among the species whose life is defined by exceedingly high annual mortality and high reproduction. Major causes of loss are:

- egg eaters, such as mammals and snakes
- animals capable of preying on full-sized quail, which include some of the above, plus raptors and hunters.

Quail also succumb to the ravages of weather, with spectacular losses easily observed when frozen quail are found in snowdrifts and icy fields, and less conspicuous deaths from hail, heat and drowning. Many quail are weakened by energy-sapping weather and shortages of food, with predators taking the final toll on these doomed birds. In such cases, predators get blamed for quail losses that would have occurred anyway.

From fall to spring more than half of the quail will die, and during summer another third of the adults expire. All told, Missouri's annual losses of quail are often greater than 90 percent. With such high losses, there's a tremendous need for population recovery each year through nesting and brood rearing. Fortunately, quail evolved many strategies to produce an abundance of offspring.

Over thousands of years of struggle with predators and severe weather, quail have evolved a tremendous capacity to overcome such losses but only when plenty of nesting and brood-rearing habitat are available.

REPRODUCTION

A review of many studies finds that spring-to-fall quail abundance increased on average 160 percent, and more than 300 percent in some cases. Quail achieve this high productivity in a variety of ways:

- Hens lay large clutches of 10 to 20 eggs.
- Hens quickly start a second or third nest if initial nests are destroyed.
- Hens are quite promiscuous and not strictly monogamous as once thought, sometimes laying a clutch of eggs and then moving on to find another mate while the first mate incubates the initial nest. Males incubate about 25 percent of the nests, according to research in Missouri and other states.
- Sometimes hens complete incubation only to abandon their brood after a few weeks. Biologists speculate that these abandoned broods are old enough to fend for themselves, or that other quail adopt them. In any case, the hen is now free to start another nest.

The management implications of nesting season length are clear. Suitable nesting cover must be available from April through September. The majority of Missouri's quail production begins with nesting in May. Many attempts will fail. About 50 percent of incubated nests hatch chicks;

Left: *Quail are prolific breeders, but the chicks' survival depends on good habitat that includes insects, bare ground and concealment cover.*

Tom Hutton

Above: *A number of different mammals, such as opossums, take a toll on eggs and nests.*

and of the unsuccessful nests, about 90 percent fail due to predation. In many cases the incubating adult also is killed. The greatest chance for nest success lies in the availability of season-long cover for second or third efforts.

Eggs are laid at a rate of slightly less than one per day; therefore, it takes a hen 15 days to lay a typical 14 egg clutch. Much of the variability in the number of days required for nesting is due to clutch size. Typically the number of eggs per clutch declines with each subsequent nesting effort. Incubation requires 23 days.

LIFE NEAR THE BOTTOM OF THE FOOD CHAIN

Predation has long been of keen interest to quail enthusiasts, and the following key points have emerged over the years:

- Quail are near the bottom of the food chain; and, thus, many species eat bobwhite.
- No predator specializes in eating quail.
- Predators are responsible for more than one-half of quail deaths each year.
- Because of the complexity of predator/prey relationships, predation is difficult to control.

Quail are vulnerable to predators their whole life. The list of animals known to have preyed on quail is impressive, and some species are not normally considered to be predators. Animals known to eat quail or quail eggs include: skunks, opossums, foxes, raccoons, cotton rats, weasels, mink, bobcats, ground squirrels, fox squirrels, gray squirrels, deer, Cooper's hawks, sharp-shinned hawks, sparrow hawks, red-tailed hawks, marsh hawks, great-horned owls, barred owls, bluejays, crows, and both domestic and wild turkey. Several species of snakes will eat eggs, chicks and adult quail. House cats and dogs sometimes prey heavily on eggs and incubating adults. Hogs are known to eat quail eggs. Even tortoises, box turtles and armadillos get into the act. In the southern United States, red imported fire ants attack newly-hatched chicks. There may be still other predators not yet identified.

Although quail are a popular food item, no predator specializes in them. This was first shown in the 1950s during Conservation Department research on quail predation by mammals. Researchers found quail remains in just over 2 percent of more than 1,000 red fox stomachs examined and in less than one percent of 770 coyotes stomachs. Fewer than one in 100 feral house-cat stomachs contained quail. The study clearly showed that these predators subsist largely on rabbits, mice and rats. Similarly, hawks, owls and foxes eat far more mice and snakes than quail.

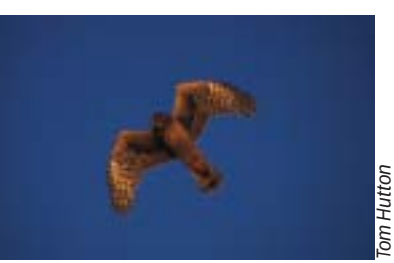

Tom Hutton

An important finding is that many of the quail's enemies eat other quail predators. Research in the 1990s in Missouri and other states identified snakes as a major consumer of quail eggs. Even rodents, particularly cotton rats, take a toll on quail nests. Fortunately for quail and their enthusiasts, predators such as hawks, owls, coyotes and bobcats help keep these egg eaters in check. The image of a round-bellied fox, coyote or hawk belching quail feathers is a handy scapegoat, but it's inaccurate.

Above: *The black rat snake eats quail eggs but it also consumes rodents, such as cotton rats, that prey on quail eggs.*
Below: *Harriers and other hawks sometimes kill adult quail, but they also help control other quail predators.*

In fact, the red-tailed hawk, which is often blamed for quail problems because it is so conspicuous, probably does far more good than bad for quail. First, red-tailed hawks prey heavily on snakes, the destroyer of many quail nests. Second, these hawks displace Cooper's hawks, a species supremely adapted to preying on quail. Similarly, coyotes take relatively few quail, but they displace the more serious nest predator, the fox.

It is difficult to define the exact impact predators have on quail populations. Much was learned about predation in the 1990s as biologists studied the secrets of bobwhite life, or most often death, by placing tiny radio transmitters on quail. Foremost, intensive study revealed that predators are responsible for more than one-half of quail deaths each year. This information, however, was not new. The earliest quail research, which took place in Iowa in the 1930s, found that predators took more than one-half of the annual quail crop.


Tom Hutton

Predators, as well as severe weather, obviously play a major role in quail life, but the species has evolved a tremendous capacity to overcome such losses by mating with more than one partner and producing multiple nests and broods. High production, however, requires abundant nesting and brood-rearing habitat, along with mild spring and summer weather. Once again the importance of habitat to quail abundance becomes clear.

No predator specializes in quail, and many of their enemies eat other quail predators.

Kristin Williams

Above: *Quail roosting behavior helps them withstand cold winter weather.*

WEATHER: CAUSE OF SHORT-TERM BUST OR BOOM

Of the many factors that affect bobwhite, weather is second only to habitat in its impact on quail numbers. The difference between these two controllers of quail abundance is that severe weather provides a short-term effect, usually less than a few years, whereas habitat deterioration can be permanent.

The importance of weather was clearly seen in the 1960s, a decade truly exemplifying the boom-bust quail cycle. Late winter weather in 1960 decimated the state's quail population, but within a few years quail rebounded and a modern-day peak was reached by the end of the decade. Other busts have occurred as a result of drought and cool, wet springs. Each year many quail are lost to snow, ice, hail, cold, heat and drought with the extent of the losses as varied as the weather patterns and quality of habitat.

HARVEST: BALANCE BETWEEN BIOLOGY AND TRADITION

As with every game animal, quail hunting is regulated to provide both optimum recreation and continued survival of a healthy population. Regulating quail harvest on a statewide basis involves practical as well as theoretical considerations, all of which must be based on sound information.

A key to regulated small game hunting is that it must take place before the majority of the natural deaths of quail occur.

For many years, biologists have debated the effect of harvest on year-to-year quail abundance. Southern plantation managers take the most conservative approach, often harvesting less than 25 percent of the population, usually by only shooting on a covey rise and not pursuing scattered birds. Such restrictions reflect the hunters' desire to maximize contacts with coveys because heavily hunted quail quickly adopt evasive behaviors, such as running, flushing wild and seeking out the most impenetrable cover. Although such restrictive hunting can provide more contacts with coveys, there's no evidence that it produces proportionally more quail in the spring and fall.

Missouri's research on quail in optimum habitat on public land revealed that many of the quail saved from the gun end up being killed by predators and winter weather, resulting in a natural decline by spring in breeding birds every year. The high natural mortality observed after the hunting season confirmed the belief that carefully regulated hunting of small game species like quail and rabbits does not reduce abundance of animals available for breeding. To work properly, small game hunting must occur before most natural mortality takes place. In the Midwest, predators and winter weather take a relatively large toll on quail after the first of the year. By working within the constraints of nature, in this case mortality during winter, we are able to hunt small game without harming year-to-year abundance. The closing of Missouri's quail season in January is a compromise between biology, hunting traditions and logistics.

Below: *Quail populations in good habitat have the ability to withstand regulated hunting.*

Cliff White

Cliff White

How many birds can be harvested without causing a population decline?

Too much harvest can depress quail abundance, and the allowable harvest depends on the quality of the habitat.

Studies in the 1990s in Missouri and decades earlier in Illinois indicate that harvesting as much as 50 percent of the quail population does not harm long-term abundance. However, both studies also found that too much harvest can depress quail abundance. For example, 83 percent harvest in 1994 on Missouri's research site depressed breeding numbers. Furthermore, quail are more vulnerable to harvest on private lands because the habitat generally is less abundant and of lower quality. The Illinois research, which took place in mediocre quail habitat, warned that harvest should not regularly exceed 50 percent.

Likewise, a Department study of mediocre farm land habitat in northeast Missouri left biologists wondering if hunting could depress quail abundance. In that study, an alarmingly high

proportion of the quail died from predation, weather and other causes. This led biologists to wonder if the area's 30 percent harvest of quail could permanently depress populations in this type of habitat.

The bewildering aspect of harvest management is in applying results from studies on relatively small areas to statewide hunting. Extreme variation in hunting pressure, weather and the quality of habitat across the state makes it difficult to apply a one-plan-fits-all regulation. These variations, even from one county to the next, can be so dramatic that statewide regulations can result in overharvest for one population while another, perhaps only a few miles away, is scarcely touched. However, with today's widespread poor habitat, quail are increasingly vulnerable to overharvest. The key to management is understanding the species' ability to survive and reproduce under current conditions and in the context of known hunting pressure.

Only quail hunters can decide when enough birds have been taken from their favorite hunting spots.

Simply making minor adjustments in season length and bag limits is not the answer. Only a tiny fraction of hunting trips produces a limit of eight quail. Lowered bag limits rarely have any significant impact on spring breeding populations. The potential benefits of a slightly shorter season or a slightly smaller bag limit are likely to be wiped out by predation and extreme weather. As a result, the Conservation Department does not limit hunting opportunity unnecessarily. Statewide regulations are designed to allow the maximum recreation and harvest without harming year-to-year quail abundance.

Ultimately, the effects of quail harvest lie in the hands of those who harvest them. Only quail hunters can decide when enough birds have been taken from their favorite hunting spots. They know their own hunting grounds better than any state agency possibly could. Wise quail hunters/managers keep detailed records of the proportion of quail harvested and avoid going too far above the 50-percent level. This is particularly true where good quail habitat is limited and isolated.

Hunting to assess quail numbers

Serious quail hunters should, as a matter of course, keep records of their hunts to document when and where they found quail, as well as to assess dog performance. Measurement of hunting activity as an index of quail numbers requires that you keep detailed records of:

- weather
- where and how long you hunted
- number of hunters and dogs
- number and size of coveys
- number of quail harvested.

Harvest is mostly a measurement of your hunting ability, but it could provide a perspective of reproductive success for any given year, or help evaluate the abundance of quail from year to year. Because day-to-day ability to find quail is highly variable, mostly due to scenting conditions that vary with the weather, it is best to hunt the same area more than once. A study of hunters indicates that on average hunters find about 50 percent of the quail on an area, but that on any given day all or none of the birds could have been found. Be sure to keep all these factors in mind when assessing your quail population.

Bobwhite Quail: Appearance, Calls and Habits

Some call them bobwhite, others partridge, yet others simply "bird." By any name, *Colinus virginianus* is an integral part of Missouri's fauna and a longtime favorite of farmers, rural residents, bird watchers and hunters. Bobwhite are colored in grays and copper, bronze and black, with a touch of white at the male's throat and above the eye; on the female, carmel replaces these swaths of white. Such differences are recognizable when quail reach 12 weeks of age. Both sexes reach maximum weight of about 7 ounces during January.

In spring, males often ruffle up a cocky topknot for a stroll among the females for an hour of whistling from a fence post or tree. The male's favorite song is his own name, *bob WHITE*, which is often imitated by starlings and mockingbirds, and a loud *quaysh* or *quEEEak*. Quail are very social, grouping together during fall and winter as coveys of 10-20 birds.

Vocalizations among quail include covey calls that sound like *hoy, hoypoo* and *koilee*; chatter within a covey, a soft *took* and *pitoo*; and when threatened by predators and hunters, a nervous but soft sounding *tirree*, followed closely by *ick-ick-ick*. If you hear the latter, get ready for an explosion of flying quail and a thrill beyond compare.

While quail do fly, they spend most of their time on the ground foraging for seeds and insects and avoiding predators. Because many current land uses provide little for quail, restoration must be a deliberate act involving considerable thought and action. To maximize your chances of success, it's necessary to understand the bird's basic biology.

NESTING

A single nesting cycle requires about 45 days, beginning with nest-site selection and nest construction. Nests are constructed on the ground typically with leaves and stems of dead grasses and forbs. Nest sites are usually where a clump of grass or other suitable vegetation forms a canopy to hide the incubating bird and the eggs. Nests often are located within 50 feet of an edge or opening with bare ground, where the nesting bird can easily forage and dust. Studies in Missouri and other states found most nests in old fields that contained a mixture of grasses, legumes, forbs and small woody plants such as briars, vines, shrubs and saplings.

Left: *The male's striking coloration and cheery call make quail one of Missouri's favorite song birds.*
Below: *The more subdued coloration of the female helps conceal the birds during nesting and brood rearing.*

Photo Courtesy of the Virginia Department of Game and Inland Fisheries

The greatest chance for nest success lies in the availability of season-long cover for second or third efforts.

BROODING

Literally, brooding is the act of an adult quail covering its chicks with its body or wings to protect the young. Chicks are brooded throughout the night during their first few weeks. Daytime brooding occurs as needed to protect chicks from danger or the elements, such as cold, rain, wind and direct sun.

Brooding also has come to mean all of the activities associated with rearing chicks during their formative weeks. Feeding is a notable example. Adults control their brood with low vocalizations as they forage, keeping the chicks close enough so all can assemble quickly if the need arises. Chicks are extremely vulnerable to the elements and predation at this time, even with the close vigilance and care of an adult. Less than one-half of the chicks live until winter.

FEEDING

Typically, quail have two daily feeding periods: one beginning at daylight and continuing for several hours, the second beginning during mid-afternoon and continuing until roosting. Abundance and quality of the food items influence the length of feeding periods. Timing and length of feeding periods may be altered by adverse weather as well as disturbances, particularly those serious enough to cause the birds to flush. Birds that have been flushed may miss a meal entirely.

Quail take practically all their food from or within 8 inches of the ground's surface. Bobwhite are not strong scratchers and are incapable of reaching food that is buried in the soil or in a heavy accumulation of dead vegetation. Fortunately the list of quail foods is extremely long. According to various studies of fall and winter bobwhite food habits, the most frequently consumed foods are seeds of native or naturalized forbs and most grains, such as corn, sorghum, sunflowers and soybeans.

All seeds, however, are not of equal value to quail. Legumes, with high protein levels, are most important during the production season. Important legumes include:

- annual lespedezas, such as Korean or Kobe
- perennial lespedezas, such as slender and roundhead but not the noxious exotic sericea lespedeza
- beggarweeds or tick trefoils
- partridge peas.

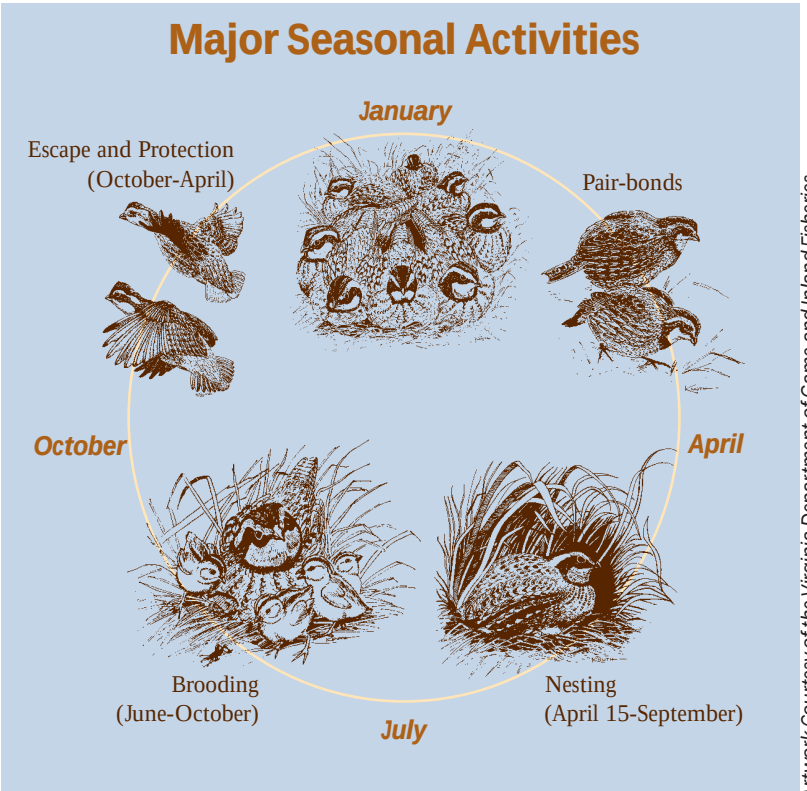
Below: *From top, beggerweed, Korean lespedeza and common ragweed, along with many cultivated crops, are favorite foods of bobwhite quail.*

Jim Rathert

Jim Rathert

Cliff White

During the winter, however, proteins are less important to quail survival than are high-energy foods, such as ragweed, corn and soybeans. The relative value of seeds to quail during winter can be calculated from the seeds' energy value and size. See chart on page 24. Moreover, Missouri research on energy needs of quail can be combined with these seed characteristics to calculate the number of seeds of different plant species required to meet the energy requirements of a single quail over a 24-hour period. For example, at 32 degrees Fahrenheit, a quail requires 49 kernels of corn, 122 soybeans, 7,248 sumac seeds or 32,570 switchgrass seeds. The energy value of seeds, however, is just a small part of what a quail faces during a cold winter day. For example, soybean fields typically have zero cover value. So although soybeans offer a quick, high-energy meal, they do not provide cover from predators and insulation from cold, windy conditions. The best combination is to have high-energy seeds and protective cover.



Artwork Courtesy of the Virginia Department of Game and Inland Fisheries

Indeed, Missouri researchers found that quail living in weedy fields have more fat than quail that inhabit corn and soybean fields. A little bit more fat, or stored energy, is a good thing for quail. If faced with severe winter weather, quail in the weedy fields have the capacity to live a few days without food, whereas less fit birds will die more quickly of hypothermia or be forced to venture out into the inhospitable cold environment. During these times, quail are highly vulnerable to predators.

Greens are an important spring and summer food, and a supplement during fall and winter. Soft ripe fruits are seasonally important, as are agronomic grains left standing or spilled during harvest. Insects in the spring and summer make up about 15 percent of a quail's total annual food consumption. Juvenile and adult quail often include insects in their diet, but they are especially important to nesting hens and fast growing chicks. Fields with weeds and legumes attract insects that quail need.

ROOSTING

Beyond revealing that quail are using an area, evidenced by piles of small white-capped droppings, nighttime roosting is a major activity that otherwise receives little attention. It deserves more. Quail roost from sunset to sunrise but will extend this inactive period during frigid weather.

Quail roost on the ground in grassy-weedy areas throughout the year except during severe wind or precipitation. They may roost alone or in pairs, but most commonly they roost in a disk formation when their numbers permit. Like the spokes of a wheel, each member of the disk positions itself with its tail towards the center and head outward. Roosting in this fashion is a social behavior; but during cold weather, it's also an aid to survival. Such a formation allows

Energy value of seeds

The relative value of seeds to quail during winter can be calculated from the seeds' energy value and size. Below is listed the number of seeds needed per 24-hour day to meet energy needs of a single quail during different temperatures.

Temperature:	70 F	32 F	0 F	0 F
Activity level:	Low	Low	Low	High
Corn	41	49	69	94
Soybean	103	122	174	236
Milo	666	788	1,121	1,520
Sunflower	1,165	1,379	1,961	2,660
Black locust	1,250	1,479	2,104	2,854
Partridge pea	3,601	4,261	6,062	8,223
Common ragweed	3,870	4,580	6,515	8,837
Smooth sumac	6,125	7,248	10,310	13,985
German millet	8,418	9,962	14,171	19,222
Korean lespedeza	9,480	11,218	15,959	21,647
Switchgrass	27,524	32,570	46,331	62,846

each member to benefit from the body heat of others. Temperature within the disk is regulated by the quality of roosting cover and how tightly the birds huddle together. The importance of the quail's defense against cold weather is easily understood from Missouri research, which found that a lone quail starts to burn extra energy to stay warm when the temperature falls below 70 degrees Fahrenheit.

ESCAPE

In his recording, "There's Nothing I Can Do About it Now," Willie Nelson sings that he "survived every situation by knowing when to freeze and when to run." There is probably not a day in its life when a quail is not faced with this decision and with survival at stake. Unfortunately, even with their added option to fly, bobwhite survival is not assured.

Missouri research on heavily hunted conservation areas found quail often run from the approach of hunters, especially if the hunters are noisy. Other quail evaded hunters and their dogs by holding tight in heavy grass. Surrounded by green grass, the quail's scent is often difficult to smell. What dogs usually smell from a bird are shed skin cells. So if a quail flies and hides in green grass, initially there are few skin cells for the dog to detect and a strong chemical background odor from the live grass helps mask the scent. Heavily hunted quail also spent more time in or near woody cover, whether it be thick brush or large woods, both of which are difficult to hunt.

Other researchers found that a quail's first reaction to a flying hawk is to freeze and remain absolutely motionless from anywhere from 10 seconds to minutes. By freezing and with the help of their well-suited camouflage, quail can frequently avoid detection in almost every situation except on snow. Although the average bobwhite flight speed is 20 miles per hour, flying is usually the quail's last resort, unless the danger is great and safe cover is nearby.

DUSTING

Essential to its well being, and one that it appears to enjoy, is the quail's habit of dusting. A depression, or dusting bowl, is scratched and pecked free of vegetation and the soil finely ground 3 or 4 inches deep. When dusting, quail immerse their breasts in the bowl and throw dust across their backs with their beaks and feet. Several birds will sometimes enter the bath together and shower one another with dust. During rainy periods, dust baths are sometimes located under the elevated portion of downed logs. Dusting helps maintain quail feathers and reduces insect parasites.

Tom Hutton

Above: *Blackberry and coral berry are important escape cover for quail in winter, as these mounted quail show.*

Basic Habitat Needs

To develop management practices to improve quail populations on your land, it's important to identify the cover types and conditions required for each stage of the quail's life cycle. Bobwhite do well on property when a mixture of the components below, with as much as 20 percent mature forest, are present on each 40 acres. The exact proportions of the various vegetative types are not as important as how the various types are situated in relation to each other and how they are managed.

Use the information below to identify which of the seven essential habitat components you already have on your land and which ones you need to develop.

Quail nests are frequently located within 50 feet of an edge or opening with bare ground, where the nesting bird can easily forage.

NESTING COVER

Preferred nesting cover includes a mix of erect grasses, forbs and scattered shrubs or brambles at a moderate density and height. Idle land, in or near the old field stage, provides the cover most frequently used for nesting. Native pastures that are moderately grazed, filter strips, and the edges of crop fields, woods and roadways often contain the mix and density of plants quail seek for nesting. Old fields and areas with similar characteristics will continue to be used for nesting as long as a diversity of herbaceous plants dominate and the ground surface is not covered with a dense mat of vegetation. No-till row crops are sometimes used for late-season nesting.

When considering the availability of nesting cover, look for areas with scattered clumps of native warm-season grasses or cool-season grasses, such as orchard grass, timothy and red top. These grasses can be good indicators of potential nesting cover, but other conditions must be considered as well. A frequent mistake is to assume that grassland, regardless of its condition, will be selected for nesting. Although grasses are frequently used for nest construction and provide the nest canopy, a monolithic stand of thick grass, even native warm-season grass, is not desirable nesting cover. Neither are recently fallowed fields because they seldom have adequate grasses.

BROOD COVER

Brood cover should be dominated by plants that have well-spaced, sturdy stems with little foliage near the ground. Overhead foliage must be dense enough to provide sufficient cover to give chicks and adults protection from predators.

Left: *Young, fragile chicks need bare ground to walk through and sturdy overhead cover for protection.*
Below: *Leaving some unharvested corn in a field allows quail-friendly plants to grow between the rows.*

Tom Hutton

Examples of good brood cover include:

- exotic and native forbs and annual weeds including ragweed, croton and foxtail
- legumes including lespedezas, clover, partridge pea, beggarweeds and tick trefoils
- corn, milo and soybeans if residue from the previous year is present.

Bare ground also is an essential element of good brood cover because a newly hatched, quarter-ounce chick is very fragile. Thick vegetation, whether erect or lying on the ground, makes it impossible for chicks to travel or forage for seeds and insects.

Along with providing protection and ease of movement, good brood cover contains an abundance of insects. For this reason, the terms "brooding" and "bugging" are sometimes used interchangeably. Though some weed seeds and greens are eaten, insects provide far greater protein, a necessity for chicks to develop rapidly. Eighty to 95 percent of a chick's diet consists of insects during its first few weeks.

The amount of food needed requires hours of foraging. Commonly eaten invertebrates include spiders, leafhoppers, beetles, grasshoppers, crickets, stinkbugs, ants, flies and snails. Brood cover

Below: *Missouri research shows that quail spend most of their time within 70 feet of woody cover. Strategic placement of woody shrubs allows quail to safely use most of the field in figure 1. In figure 2, quail will not be as safe if they venture too far from the brushy edge into the gray shaded area*

Figure 1

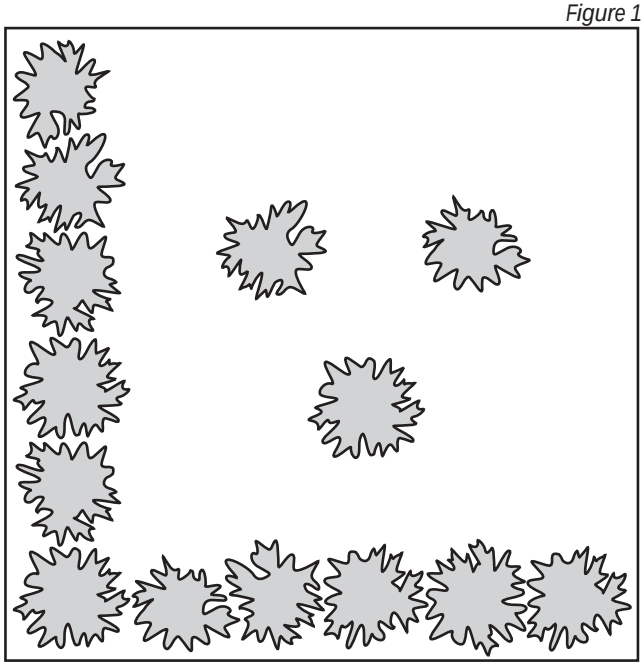
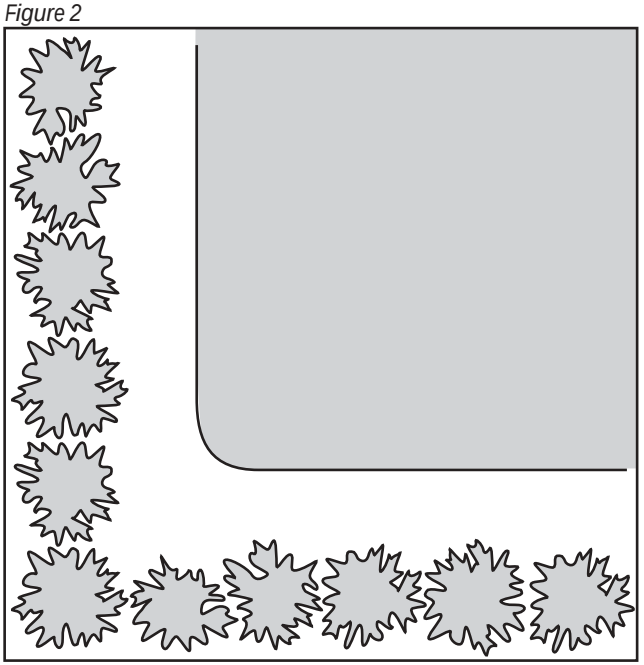


Figure 2



Patrick Kipp

that is open enough for chicks to pursue and capture insects reduces foraging time and the vulnerability of chicks and adults to predators and the elements.

FEEDING COVER

For fall and winter feeding, idle lands in the fallow stage are among the best because they have bare ground, cover and, usually, an array of seed-producing annual forbs for food. Old fields also provide suitable feeding areas if there is not too much litter.

Food items found in old fields include perennial forbs and fruit-bearing woody plants. Some of the more utilized grass seeds, those of panic, crab and foxtail grasses, also are usually present in old fields. The mast of pioneer woody species, including dogwood, sumacs, coral berry and sassafras, provide another source of food in old fields and fencerows. The seeds of oaks and hickories are important food items found in woodland areas. Nuts and acorns are eaten whole or as fragments.

Tom Hutton

Above: *Unharvested milo provides both food and cover for quail in the winter.*

ROOSTING COVER

Roosting is probably the only bobwhite activity where dense overhead cover is usually not required. Research shows that quail use crop fields, grasslands and old fields for roosting. Apparently the birds' camouflage and motionless state while roosting eliminate the need for cover overhead. The open skyward view also allows birds to flush unobstructed during darkness when approached by predators. Quail roost on both bare soil and vegetation litter. Dark-colored bare soil that receives sun light could provide a warmer surface during night and keep quail warmer. On the other hand, vegetation litter insulates quail from frozen soil. Roosts often are located on a south or southwest slope where the afternoon sun is direct and has warmed the ground. Quail prefer mid-slope or lower elevations for roosting, presumably to avoid winds at higher elevations.

Open herbaceous cover provides year-round roosting areas. Common plants include native warm-season grasses, broad-leaved forbs and grasses. During and after snow and ice storms, quail use woody cover or stiff-stemmed herbaceous vegetation, such as big bluestem, Indian grass and switch grass. Fescue and other cool-season grasses do not provide good cover because they collapse under snow or ice.

Good brood cover has an abundance of small insects and is open enough for chicks to pursue and capture them.

Missouri research has revealed some of the secrets of quail roosting. Of the two favorite roosting habitats, weedy grasslands and woody draws, the latter provides the warmest cover. Further, taller grasslands do not provide warmer cover than very short grasslands. This is because wind speed at the height of roosting quail, about 3 inches above the ground, is near zero even if vegetation is absent. So why do quail roost so often in fields of medium to tall herbaceous vegetation? Researchers suspect the quail are trying to avoid detection from predators perched in trees or walking the edge of fields. The research also has found relatively high predation on quail when the birds move to woody cover after snow and ice storms.

For winter survival, the best combination is to provide high-energy seeds, along with protective cover.

ESCAPE COVER

To a degree, any concealing vegetation can serve as escape cover. More often, though, escape cover implies dense cover, usually a thicket combining trees, blackberry, coral berry, other brush and vines. This type of cover is an absolute requirement within a covey's winter range. According to research on Texas rangeland where there are many scattered patches of woody thickets, the average flight distance for quail is 141 feet. Similarly, Missouri research found that quail in winter spend most of their time within 70 feet of woody cover. Crop fields and large grasslands, such as pastures, old fields and prairies, can be made more suitable for quail if good woody cover is within 100 feet or so of the center of the open land.

COVEY HEADQUARTERS

Usually an element of escape cover is the covey headquarters. These areas are occupied during mid-day for loafing and dusting, and for protection and roosting during severe weather. Small wood lots with a dense understory or a finger of woodland extending into openings will sometimes serve as winter headquarters. Within crop fields, outcroppings of trees with a brushy cover beneath also are used for this purpose. With a dependable food supply nearby and without undue disturbance, these areas will be used for extended periods. Headquarters of different coveys are rarely, if ever, shared and tend to be well separated.

DUSTING AREAS

As long as there is some recent soil disturbance throughout the area, no further effort need be made to provide dusting sites. Cow paths, ant hills, watering holes, roads and trails often provide these areas for quail. If there is no disturbance, disking can create the needed bare soil.

Left: *Properly managed quail-friendly grasses are used for nesting, roosting and brooding. These include little bluestem (left), eastern gama grass (top right), and other native warm-season grasses (bottom right). Mounted quail are included for scale.*
Below: *Dense shrub thickets provide secure loafing and escape cover.*

Tom Hutton

Photos by Cliff White

Managing Habitat: Critical First Steps

If you are interested in managing for quail on your property, there are important questions you must answer about the availability and condition of quail habitat components. These points identify the scope of your land's potential for quail, and, consequently, the amount of effort required to bring quail back. Take inventories of current conditions by answering the following:

- What is the nature and distribution of vegetation on your land? Use the information in the previous chapter to assess your land. Use aerial photographs or topography maps to identify existing and potential quail habitat.
- What do neighboring lands offer for quail? If your land is a small island of potential quail habitat in a sea of poor quail habitat, your chances of success are slim until you get cooperation from neighbors.
- How many and where are the coveys? Quail numbers can be obtained by various methods, including hunting activity, incidental field observations, breeding-season whistle counts and October covey whistle counts. See Appendix A, on page 56.

Good quail management is an art that is learned from science and experience. It requires hard work and a good understanding of:

- the quail's biological needs
- the techniques and timing to create them
- the capability of your soils.

Landowners who work diligently to provide quail habitat will be rewarded with larger and more stable quail populations. Many other animals will benefit as well.

Below: *Aerial photos can help plan quail habitat improvement management and identify covey headquarters.*

Creating the Right Habitat

Quail are birds primarily of open country. While they do eat acorns and pine nuts, land that has a high percentage of dense, mature forest is not well suited for quail. Generally they need:

- grasslands that provide nesting, roosting and insects to eat
- seed-producing plants, including crops and weeds, for food and cover
- brambles and shrubs for fruits and cover
- bare ground for dusting, drying and easy mobility.

Fortunately, bobwhite quail can live and prosper in a wide range of land types and climates, from Canada to the Gulf Coast and from Colorado to the East Coast. Unfortunately, quail habitat in Missouri has been decreasing for the last 40 years. This trend can be reversed if landowners understand the components of good quail habitat and how to create it, and manage their land accordingly. Good quail management is compatible on land that is in agricultural production that must produce income.

Even in good habitat, quail populations naturally will fluctuate because of weather extremes during winter and the nesting season.

CROP FIELDS

Crop fields of corn, milo, millet, sorghum, sunflowers and soybeans provide a large percentage of the quail's winter diet. These large, high-energy seeds allow quail to maintain good body condition when cold weather demands that these small birds ingest enough food to keep from freezing. In addition, quail hens that come through the winter in good condition are able to more fully attain their high reproductive potential during the growing season. These grains also allow quail to meet their energy needs in a minimum of foraging time and reduce their exposure to predators, if good escape cover is nearby.

The size of Missouri's crop fields has steadily increased over the last 40 years, leaving little room for the other major components of quail habitat. If these components are available on each 40 acres, the ideal field size would be 10 acres or less. Fifteen acre fields can provide adequate habitat, especially if they are shaped advantageously. Crop fields larger than 20 acres place major limitations on quail populations, but may be improved by using the following management techniques.

Use contour strip cropping: Contour strip cropping can allow the land to produce agricultural products and generate income, help control soil erosion and provide some components of quail habitat.

Below: *Missouri's crop fields have been enlarged to accommodate large equipment and more efficient farming; and as a result, quail habitat has been reduced.*

Cliff White

Above: *Contour strip cropping and good crop rotations reduce soil erosion, builds soil fertility and provides several essentials for quail.*

With 50- to 100-foot grass strips between every second or third crop strip, nesting, brood rearing and food are provided in a relatively small area that is readily accessible by this ground-dwelling bird.

Plant and rotate quail-friendly crops: Cotton, rice and cucumbers provide few, if any, benefits for quail. In fact, cultural practices, including pesticides, cultivation and harvest of these crops, nearly preclude any benefits for quail. At the same time, a crop rotation that includes corn, milo or sunflowers, and soybeans, wheat and lespedeza in successive years is nearly an ideal situation from a quail's standpoint. This crop rotation also helps control crop insect pests, reduces commercial fertilizer needs and soil erosion, and adds organic matter to the soil. Corn and milo generally provide more benefits to quail than do soybeans and sunflowers because the harvested fields have more cover after harvest if the crop stubble is not mowed, disked or plowed in the fall.

Extra touches for crop fields

While the cropping approaches described above do not provide quail habitat on every acre throughout the year, they do supply important habitat components at the right times. Landowners who place high priority on quail and have the financial latitude to do so can improve quail habitat further with the following techniques.

Create a buffer: On land that is largely crop with wooded drainages and borders, installing a 30-foot buffer strip of grasses and legumes will help control erosion, filter sediment and pesticides, as well as providing quail nesting, brooding and roosting habitat.

Use less herbicides: Modern herbicides have improved weed control in crops so dramatically that many fields are nearly weed free. This is good for crop production, but not for quail. Important brood habitat will be created if herbicides are not used on the two outside rows of crop, next to good cover. These unsprayed areas will develop into a weedy, grain crop strip during the growing season that provides bare ground for easy mobility, overhead cover for protection from predators, more insects for the chicks to eat and areas where they can dry off after a

rain or heavy dew. If this strip is left unharvested in the fall, it also will provide food and cover during the winter. This may look like sloppy farming, but quail love it!

Overseed winter wheat: Another way to provide excellent brood habitat is to overseed winter wheat in January or February with 4 pounds of Korean lespedeza per acre, then leave the field idle after the wheat is harvested. Important quail foods like ragweed and foxtail will grow naturally and, combined with the lespedeza, provide good brood habitat during the summer, along with food and cover for winter.

Below: *Buffer strips between crop fields and drainages help control erosion, filter sediments and pesticides, as well as provide quail nesting, brooding and roosting cover.*

Above: *Intensively used fescue pastures and clean fencerows leave quail out in the cold in the winter.* ***Below:*** *Native shrubs are used as covey headquarters and provide good escape cover, especially in winter.*

GRASSLANDS

Before European settlers arrived, quail thrived on the edges of Missouri's grasslands, prairies, glades and savannas. Although most of the state's prairie has been converted to other vegetation and uses, Missouri's grasslands can still support good quail populations when the right management techniques are used.

Tall-fescue pastures

Tall fescue is the most common pasture grass in Missouri. Although its aggressive nature and the heavy grazing pressure required to maintain its benefits for cattle often limit important quail plants, there are ways to improve tall fescue pastures for quail. The challenge is to reduce the dominance of tall fescue so the plants that provide food and cover for quail can coexist.

Plant or protect shrubs: One of the most economical ways is to plant or protect scattered strips of blackberries, plum, sumac and coral berry, which the birds will use as covey headquarters.

Don't mow: Fescue pastures that receive continuous heavy grazing and are mowed completely to remove shrubs and weeds are useless for quail. Skipping small strips when mowing pasture weeds provides them cover. Less than 5 percent of a pasture devoted to unmowed shrubs and weeds can make a significant improvement in quail habitat throughout the year. To provide abundant overhead cover for quail, completely forgo maintenance mowing of pasture weeds.

Tom Hutton

Graze and overseed: To encourage seed-producing plants for quail food, graze monotypic stands of fescue heavily in late winter and then overseed the pasture with lespedeza and red clover. Both of these plants will provide nutritious greens for hens and support good insect populations, important foods for nesting hens and rapidly growing chicks. In addition, lespedeza will sup-

ply seeds during the fall and winter. If these pastures again receive heavy grazing pressure from April 1 until May 15 and are rested through the summer, the fescue can be adequately suppressed. In addition, these actions will allow the growth of plants that provide brood habitat and quail foods, such as ragweed, croton, partridge pea and lespedeza.

Disk: To provide additional quail food and cover, disk or apply herbicide to small, scattered strips throughout the pasture. This will reduce the tall fescue and allow more native annual weeds to grow.

Pastures of other cool-season grasses

Bluegrass, timothy, orchard grass, redtop and brome can provide cattle pasture and good quail cover if they are managed properly. All of these grasses tend to be less aggressive than tall fescue and generally cannot be grazed as intensively and still maintain the stand. Consequently, these cool-season grasses provide better quail habitat because other plants can more easily coexist with them and residual grass that can be used for nesting and roosting is left in the pasture. Overseeding these pastures with red clover and Korean lespedeza, along with maintaining good strips/patches of shrubs and weeds, makes these pastures reasonable quail cover.

Cliff White

Above: *Frequently mowing grass fields removes most quail habitat components.*

Native warm-season grass pastures

Native warm-season grasses, such as Indian grass, big bluestem and little bluestem, have definite advantages for quail, at the same time that they increase the profitability of a cattle operation. Described as "bunch" grasses because they grow in clumps, these native grasses allow other important quail plants to exist with them and provide easy access for quail to walk between them. On fertile soils with Missouri's average rainfall, however, even these native grasses can quickly become too dense for good quail habitat. If so, occasional disturbance is necessary for the field to stay productive for quail.

Unmanaged, tall fescue is detrimental to quail

- Fescue is an aggressive cool-season grass that crowds out other plants that quail need.
- Fescue seeds lack the nutrients needed for a healthy quail, according to recent research in Kentucky.
- Unmanaged fescue in fields and waterways becomes too thick for quail to feed in or move through.
- Fescue pastures are typically grazed heavily year-round and mowed in late summer to remove any weeds and brush, which destroys almost all usable food and cover for quail.

Jim Grace

Above: *Periodically burning warm-season grass pastures creates bare ground, stimulates quail food plants, and controls woody invaders.*
Below: *Including native legumes and wildflowers in warm-season grass pasture planting provides more complete quail habitat.*

Most cattle operations would benefit if a third of their pastures were in native warm-season grasses, which grow actively and are most nutritious during the warm summer months when cool-season pastures of tall fescue and bluegrass are generally dormant, less nutritious and unpalatable to the cattle.

Plant a variety of grasses: While native warm-season grasses can be planted in monocultures, cattle and quail both benefit if three or more are planted as mixtures. The benefits for quail and livestock can be further increased if these pastures are overseeded with Korean lespedeza as needed to maintain its presence.

Rotate pastures: Pastures of native warm-season grasses should be grazed in rotation and/or at stocking rates that allow an average of 10-12 inches of grass stubble at the end of the growing season. Of course, the object and beauty of grazing these native grasses is that the cattle create a variety of "structure" that provides roosting, nesting, foraging and dusting areas, as well as cow paths for quail to reach them easily. Warm-season grasses grazed in this fashion have the added benefits of providing good habitat for Missouri's other native grassland birds.

Burn: Native warm-season grass pastures should be burned at three- to four-year intervals to help maintain the vigor, palatability and nutrition of the grasses. These burns will improve cat-

tle performance, help control the invasion of shrubs, stimulate production of seed by grasses, legumes, weeds and wildflowers and boost fruiting of blackberries, dewberries and other woody shrubs. It's better for quail and other wildlife if the fields are burned in patches, rather than completely, to provide residual cover for concealment until the vegetation regrows. Annual burning of an entire pasture is detrimental to good quail populations because the birds use dead grass from the previous year for nesting and concealment.

Install fences: Pastures should be designed to exclude forest and woodlots and allow a fringe of dense shrubby cover along their edges wherever practical.

Control woody invaders: While prescribed burning and grazing will help control woody species that start to invade, selective mowing, grazing by goats or herbicide application eventually will be necessary. When this time arrives, remember that quail require that some fruiting, woody shrubs remain in the pasture, but trees should be heavily thinned or removed completely.

Jim Rathert

Above: *Properly managed grazing can be an important tool for keeping grasslands productive for quail.*

Plant native legumes and wildflowers: Remembering that quail evolved in close association with Missouri's native plants, pastures of warm-season grasses can be enhanced both practically and aesthetically with the addition of several other native grasses, legumes and wildflowers. Tall dropseed, sideoats grama, eastern gama grass, beggarticks, Maximilian sunflower, rosin weed, ashy sunflower, partridge pea and slender lespedeza also will benefit cattle, quail and other native wildlife. Be aware that seed and plugs of some of these species can be expensive, so you may need to limit quantities according to your budget.

Cool-season grass hay fields

Cool-season grasses, such as tall fescue, timothy, orchard grass and bluegrass, have a serious limitation for quail when used for hay. To get the best quality hay from these grasses, they should be harvested in late May and early June. Unfortunately, this is prime nesting time for quail and other

Tom Hutton

Above: *Bison once helped create the vegetative and structural diversity in Missouri's prairies that quail need.*

grassland birds. Haying the fields at this time destroys many nests and sometimes kills the adults. To help reduce the loss of quail and nests, leave an uncut 50-foot grass border around the field until after July 1. To provide more insects and seed after the hay is harvested, periodically overseed the fields with lespedeza and red clover.

Native warm-season grass hay fields

Like pastures, native warm-season grasses can be planted in monocultures for hay, but are of more benefit to quail if planted in mixtures of native grasses, along with Korean lespedeza and/or native legumes and wildflowers mentioned above. These plantings can be hayed between July 1 and Aug. 15, after the prime quail nesting season, and still have time to regrow and provide food and cover for the rest of the year. Landowners can favor either the grasses or broad-leafed plants according to their objectives. Generally, haying in early July favors the grasses and haying late in this period reduces the vigor of the grasses and favors the seed producing plants the following year. Native warm-season grass hay fields, like pastures, need periodic prescribed burns to remain most productive for hay and to benefit quail.

Prairies

Most of Missouri's prairies have been converted to other uses. If you have existing remnants, you already have some valuable quail-habitat components. The addition of some native shrubs and proper management as described in the sections on native warm-season grass pastures and hay can produce good quail habitat and generate income from this scarce resource.

Learn to burn safely

Anyone planning a burn should have the training to do it safely. Contact your local Conservation Department or Natural Resource Conservation Service office to learn about short courses and professional assistance to help you learn the safe way to conduct a prescribed burn. See pages 59 and 63 for information on locating these offices in your area.

The Department also has available for purchase the video, "How to Manage a Prescribed Burn." See page 59 for ordering information.

Native warm-season grass, legume and wildflower seed are increasingly in demand for landscaping, cut flowers, renovating highway rights-of-way, as medicinal herbs and for lands in the Conservation Reserve Program. Because they are adapted to grow in Missouri, these plants benefit wildlife, are aesthetically attractive and add nutrients to the soil.

Although each species has somewhat different requirements for good seed production, some general guidelines can be followed. Prescribed burning can increase seed production of most prairie plants, assuming there is good subsoil moisture and average summer weather. The key is the timing. For grass-seed production, a burn conducted in the first half of April will favor grasses and boost seed production. A prescribed burn in late summer or from mid-February to mid-March will increase seed production of the native legumes and wildflowers. Burning in late summer and late winter generally creates the best quail habitat by creating lots of seed-producing plants and bare ground between less vigorous grasses.

Above: *Periodic fires are an important tool for rejuvenating and maintaining prairies and warm-season grass plantings.*

Below: *Properly managed glades can contain many important quail plants and allow the birds to survive in parts of Missouri that are largely dominated by forest.*

Glades

Glades occur primarily on rocky, south and west slopes in most of Missouri. In parts of the Ozarks they cover entire mountaintops and are known as "balds." Glades can be managed for quail much like prairies, except that they are much dryer, have less total production and need less frequent disturbance.

Jim Rathert

Prairie and glad remnants

There are undoubtedly hundreds of acres of restorable prairie and glade in Missouri that are unrecognizable as such. Invading cedar and hardwood trees, bluegrass and tall fescue often dominate these sites, and the native plants are hard to find. Many times, they become recognizable only after prescribed fire, chainsaw work or herbicide application gives them room. Heavy grazing from early April to mid May for several years in succession also can help reduce dominance of bluegrass and tall fescue when restoring prairie remnants.

Conservation Reserve Program

The Conservation Reserve Program has provided important benefits for wildlife while reducing soil erosion for nearly 20 years. This federally funded program allows landowners with highly erosive land to establish permanent vegetative cover, such as grass or trees. In return for taking the land out of production, the landowner is paid a certain amount per acre each year.

Although CRP fields provide benefits for pheasants and other grassland birds, they generally contain a good mixture of annual weeds and grasses for two to three years after planting. During that time, they provide good quail habitat only if there is brushy cover in draws or around the borders of the field. After three years, almost all fields will require periodic disturbance to remain productive for quail. Fields with low soil fertility or rainfall may go four years before needing disturbance.

Select quail-friendly grasses: Since the main components of all CRP plantings are grasses, the ones selected for planting largely determine how useful the planting will be for quail and how often disturbance will be required to keep the grasses from dominating completely and eliminating the seed-producing plants and bare ground. Native warm-season grasses or a mixture of timothy, red top and orchard grass are better than tall fescue for quail. All of these grasses are either bunch grasses or are less aggressive than tall fescue.

As in establishing pasture, it's important to include seed-producing plants, such as rosinweed, ashy sunflower, Maximilian sunflower and Korean lespedeza. Landowners who are more interested in wildlife and less in agricultural production will include a larger proportion of little bluestem and smaller portions of Indian grass and big bluestem in their plantings.

Photo Courtesy of the Virginia Department of Game and Inland Fisheries

Above: *Periodic disking of CRP fields is essential to keep them productive for quail.*

Disk: One of the best techniques for decreasing dominance of the grasses and stimulating the growth of quail-food plants is periodic disking. Disking one third of a CRP field annually in 30-foot wide contour strips and moving the strips to be disked each year can keep the field in good quail habitat and still meet the goals for soil erosion. The accumulated grass litter sometimes becomes so dense that it may be necessary to burn before disking.

Burn: Prescribed burning is another technique for reducing the dominance of the grasses and stimulating quail-food plants. When using prescribed fire, timing is critical. Burn at the wrong time, and you may just increase grass dominance. Native warm-season grasses should be burned in summer or late winter. Tall fescue should be burned in late April or early May. Brome,

Above: *Applying herbicides to fescue and brome before edge feathering and renovating fence rows will help maintain these grasses from eliminating bare ground and quail-friendly plants.*
Below: *Without periodic disturbance, idle areas can become choked and largely unusable by quail.*

bluegrass, timothy, red top and orchard grass can be burned anytime from late March to late April to reduce the coverage of these grasses.

Use herbicides: A variety of grass herbicides on part of the field each year will accomplish nearly the same effect as a prescribed burn. The herbicides stunt the grass and allow the other plants to flourish and produce seed. How often you need to spray will depend on the effectiveness of the herbicide and subsequent rainfall.

Create high-energy food: Planting corn, milo and forage sorghum food plots in some of the disked or sprayed strips provides high-energy food to help quail survive in severe winter weather. Rotating these food strips each year creates ideal brood habitat in the idle plots from the prior two years.

IDLE AREAS

Many farms have small areas that are left idle either because they cannot be cropped, grazed or hayed efficiently, or that are being left for wildlife. Sometimes entire properties are purchased and left undisturbed for wildlife. Idle areas with the right mixtures of grasses, weeds, shrubs and bare ground are heavily used by quail. Landowners who are interested in quail management, however, must recognize that most of these areas need disturbance to stay productive. Fields

with fertile soils must be disturbed more frequently than fields with shallow, clay or rocky soils.

Tall fescue

The most common detractor for quail habitat in idle areas is tall fescue. This aggressive cool-season grass invades these areas and crowds out important quail plants. To improve these areas for quail habitat, use the following management techniques.

Tom Hutton

Use herbicides: Applying glyphosphate between Oct. 1 and the first hard frost, or between April 1 and May 15, can reduce fescue and allow annual weeds to flourish. If native prairie plants are present, be sure they are dormant before applying the herbicide.

Burn: Under the right circumstances, prescribed burning can accomplish many of the same objectives with less cash outlay. Burning, however, may require more manpower; and the benefits are generally shorter lived. For best results, burn fescue in late April or early May.

Disk: Plowing or heavy disking are effective ways to decrease fescue, but it may harm quail-friendly plants, as well. Unless the idle area is less than an acre in size, disturbing one third of it each year in rotation generally will create good conditions for quail.

Above: *Heavy prolonged grazing of forests eliminates quail food and cover plants.*
Below: *Burning fescue during the first two weeks in May reduces the dominance of fescue, creates bare ground and stimulates quail foods.*

Tom Hutton

Trees

While trees can help break the wind during severe winter weather and some tree species provide food, too many trees, too close together, work to the detriment of quail. If idle areas are left undisturbed for many years, trees eventually shade out grasses, shrubs, native legumes and wildflowers, and annual weeds. The area becomes a dense forest and poor quail habitat. The degradation of quail habitat is accelerated if these areas receive prolonged heavy grazing by livestock, or if deer are overabundant in the area and browse out most of the understory plants.

FENCEROWS AND DRAINAGES

Cliff White

Above: *Fence rows and drainages with native shrubs provide important quail habitat.* ***Below:*** *Ungrazed Osage-orange hedgerows with an undergrowth of coral berry and blackberry bushes are excellent quail escape cover.*

Shrubby fencerows and drainages provide important quail habitat. Like idle areas, they will become less useful for quail if left undisturbed and if they become dominated by fescue, brome or trees. Periodic treatment of these grasses and trees is essential to keep fencerows and drainages in good condition.

Trim hedgerows: Even Osage-orange hedgerows, the epitome of quail habitat to many Missouri hunters, should be cut periodically to ensure that the shrubs and grasses are not completely eliminated by the hedge trees. Spraying to remove brome or fescue prior to cutting trees provides improved quail habitat for a longer time. If these cool-season grasses are not sprayed, they become more dominant after the trees are removed. Periodic cutting also allows the landowner to realize some financial return from hedge corner posts salvaged in the process.

Leave brush piles: Treetops or brush piles left as part of the process provide immediate cover for quail. The goal is to maintain shrubs and tree tops with a "high-stem density" through which quail can walk easily, but larger animals can't.

Spray fescue: The easiest way to thin fescue is to spray it with glyphosphate herbicide when it is actively growing in the fall or spring and the desirable native shrubs and grasses are dormant.

Spray trees: Invading trees can be spot sprayed with a foliar herbicide during the growing season, or the trees can be cut and the stumps treated with herbicide.

SAVANNAS

Missouri originally had extensive areas of oak, pine and mixed oak-pine savannas along the edges of the prairies and glades. These savannas consisted of a scattering of post and blackjack oak

trees and/or short-leaf pine trees with an intermittent understory of shrubs. The ground cover of grasses, legumes and wildflowers, maintained by periodic fires, were good quail habitat. Many of the native savanna trees were logged, and the areas remained undisturbed for many years afterwards. In the absence of disturbance, the stumps sprouted numerous stems to become thick stands of trees that shade out the other plants that were originally present. Restoring these savannas, if they are present on your land, will improve habitat for quail and restore some of Missouri's native diversity.

Cut trees: Restoring savannas takes hard work and several years, no matter how it is done. The quickest way is to cut a substantial number of the trees and treat the stumps with herbicide. After the trees have been thinned, periodic prescribed burning will stimulate the other plants and help suppress further tree sprouting. Light grazing with cattle, goats or horses in the spring and early summer also may help suppress the trees, reduce grass stands after they've recovered and generate some income.

Burn: Another way to restore a savannah is to use prescribed burning alone. This process involves burning every other year for as long as 10 to 20 years. The burns gradually thin the trees and stimulate the other plants that have been suppressed. With good fire lines, this approach generally requires less labor, but a lot more patience.

Tom Hutton

Top: *Well-maintained savannas can be excellent quail habitat.*
Above: *Burning savannas periodically stimulates an abundance of quail foods.*

Above: *Edge feathering quickly creates quail concealment cover along the forest border.*
Right: *Thinning trees in a forest allows lower growing plants to flourish and improves quail habitat.*

FOREST AND WOODLANDS

Forests and woodlands can provide important winter shelter and food, if there is enough good concealment cover in the form of shrubs and grasses under, between or near the trees. If that concealment cover is absent, it can be created rather quickly.

Edge feathering and shrub planting

The quickest way to provide good concealment cover is to cut the trees in a 50-foot strip along the forest edge. Sell the logs or use as firewood, leaving the tops for immediate cover. Within a year or two, this strip will sprout with briars, brambles, grasses and weeds that are ideal quail

escape cover. Treating the tree stumps with herbicide will lengthen the time that the strip will furnish good cover without additional cutting. As with fencerow renovation, it's important to spray any fescue or brome before the trees are cut.

Another way to provide the concealment cover is to plant a mixture of blackberry, plum, greenbriar, coral berry, sumac, grape, and rough-leaved dogwood along the outside of the forest edge. This strip will take longer to develop but will eventually provide important habitat for quail and other wildlife. Invading trees should be removed to prevent the strip from becoming forest.

Planting shrubs to develop the desired cover takes longer and also converts fields and pasture to another use. Edge feathering, if the tree stumps are treated, converts forest to another use. The landowner can choose which approach is best for them considering their objectives and financial situation. Some landowners may choose to do some of both, planting additional species that aren't present after doing edge feathering.

Large-canopied trees with scant understory give predators easy access to quail and provide inadequate protection from winter weather.

Forest thinning

The most economical way to create quail habitat in the forest is to periodically harvest trees for lumber or firewood. How you harvest the trees depends on the amount of forest. On the property with limited forest area, use group cuts. If the forest is more extensive, use small clear cuts. Both approaches remove the forest canopy and allow lower growing plants to flourish for four or five years, providing improved quail habitat in the process.

Another way to improve forests and woodlands for quail is to heavily thin the trees with a dozer or chainsaw, then maintain the resulting savannah with periodic burning, disking, and/or cutting and herbicide treatment.

Cliff White

Although habitat is the key to restoring quail populations, many people think that predator control, stocking and artificial feeding are the answers. People reach for simpler solutions because the needed habitat changes are complex, extensive and require hard, dirty work. However, habitat restoration is the only technique that is backed by research and brings lasting results.

PREDATOR CONTROL: DOES IT WORK?

With modern land use rendering large areas unsuitable or marginally suitable for quail, desperate bobwhite enthusiasts are asking why we don't wage war on predators, the species' greatest source of mortality. The success of predator control in increasing bobwhite populations varies from place to place, from season to season, according to the number of quail, and the number and kinds of predators and other prey animals.

Predator control has been practiced for years throughout bobwhite range, but it has never proven to be a substitute for habitat management. The most definitive study of habitat management and predator control occurred in North Carolina in the late 1990s. For three years, biologists measured quail numbers under four types of management:

1) Good habitat: crop fields with grassy/weedy borders
2) Poor habitat: crop fields without grassy/weedy borders
3) Good habitat and predator control: crop fields with borders and predator removal
4) Poor habitat and predator control: crop fields without borders and with predator removal.

Predator removal consisted of trapping all the common furbearers including opossums, raccoons and foxes during late winter and spring. Trapping in spring just prior to quail nesting was necessary because extensive migration of predators would have resulted in trapped areas being quickly repopulated by predators. Researchers found the highest quail numbers where field borders and predator removal occurred together. Close behind were the areas where only crop field borders were present; however, because of the high cost to remove the predators, the authors concluded that predator control was not practical for the small gains achieved. In the areas without field borders, predator removal did not increase quail numbers. Researchers observed that predator removal did little to help quail because untrapped predators, in this case snakes and cotton rats, took advantage of the lack of bigger predators and consumed more than their regular share of the quail eggs.

Because of the lack of habitat and record low quail numbers, the search for successful predator management techniques continues. In the end, however, quail managers will likely conclude

Predator control has been practiced for years throughout bobwhite range, but it has never proven to be a substitute for habitat management.

Below: *Striped skunks and other predators eat quail eggs; but in good habitat, quail can withstand the loss.*

Tom Hutton

Jim Rathert

Above: *Turkeys are insignificant quail predators; however, more good turkey habitat means less quality quail habitat.*

that the ineffectiveness and expense of trapping render this approach too impractical.

The "disease" affecting quail is poor habitat, and predation problems are only a symptom, not the cause. Further, the hunters' emotional concern about predation takes the focus off habitat restoration, which is the key to long-term quail restoration. Moreover, if researchers conclude that the high mortality of quail must be reduced to allow the species to maintain healthy population levels, the only mortality agent that can be easily controlled is harvest by hunters.

TURKEYS AS PREDATORS

Turkeys are widely rumored to be a major culprit in the demise of quail. Coincidentally with the decrease of quail late in the 20th century, wild turkey populations have increased across much of the United States. Hunters' perception of the rise of turkeys and fall of quail is colored by the reintroduction of wild turkeys into many areas containing suitable turkey habitat, where quail had previously flourished.

Is there a link between the rise of turkeys and fall of quail? Yes, it's habitat! Turkeys and quail have some similar habitat needs, for example, weedy areas for bugging by chicks and row crops for winter food; however, the trees that turkeys require for roosting spell trouble for quail. While quail require brush, briars and tangles to protect them from winter elements, natural plant succession leads to the replacement of these vegetation types by large-canopied trees. With this tree growth, quail lose their hiding places while the large trees provide handy perches for quail predators, such as hawks and owls. Lacking specific management for quail, Missouri's landscape has slowly evolved into poorer cover for quail and better cover for turkeys and deer.

Is there a link between the rise of turkeys and fall of quail? Yes, it's habitat!

Although instances of turkeys eating quail chicks have been reported, the phenomenon is extremely rare. Indeed, with the exception of a single biological report in Florida of indirect evidence of turkeys eating quail eggs or chicks in the early 1900s, no biological study since that time has documented the phenomenon. This lack of solid evidence is remarkable because of the proliferation of turkey and quail research during the past 50 years. Turkey researchers have not found a single quail while examining thousands of turkey stomachs. In addition, quail researchers using radio transmitters and remote cameras have documented thousands of

cases of predation by snakes, furbearers and crows, as well as deer and armadillos. No turkey, however, has yet been caught in the act.

STOCKING

At first glance, stocking seems to be an easy way for state agencies to restore quail populations. But like most quick fixes, it doesn't bring lasting results. By the turn of the 21st century, all state natural resource agencies had abandoned release of pen-raised quail for restoration because the practice was not economical and didn't permanently increase quail populations. Stocked birds must come either from game farms or from the wild. Game-farm quail simply lack survival skills. Wild birds have to be live trapped, which is difficult and expensive.

Hunters often ask why we don't restore quail through trapping and transplanting as we did with deer and turkeys. The answer is habitat. If the habitat in the area is too poor to support wild quail, stocked birds can't survive there, either. Any birds released in such conditions are doomed from the start. Without good protective cover, they're as safe from predators as fish in a barrel; and without a combination of cover and food, any birds that do mange to avoid being eaten stand little chance of surviving the winter and nesting successfully. Deer and turkey, on the other hand, have thrived because Missouri's landscape now provides better cover for them.

If the habitat is too poor to support wild quail, stocked birds can't survive there, either.

In the past few years, some entrepreneurs have gained attention for their attempts at quail propagation. Most involve some kind of shelter to protect birds and provide food, and predator control to decrease the chances of the less-than-wild quail being eaten by something other than the hunter who paid for the birds and the equipment. Researchers in Virginia tested one of the most popular systems: the anchor covey or covey base camp. Wild and pen-raised quail were equipped with radio transmitters and monitored to determine how long they would survive. The pen-raised quail died at a high rate and within weeks all were gone, demonstrating their inability to avoid predators.

ARTIFICIAL FEEDING

Artificial feeding during rough winters is another quick fix that's been discussed for years. Scattering some grain here and there may put some food into the bellies of a few birds, or it might not because a half inch of fresh snow or even a few good gusts of wind can cover it in minutes. Even when artificial feeding works perfectly, it benefits a minuscule fraction of the total quail population. At worst, it creates a false sense of accomplishment and merely clouds the real problem—dwindling habitat.

Appendix A: Whistle counts to asses quail numbers

The key to accurate year-to-year, or place-to-place, counts is to be consistent about everything you can control:

- same people listening
- same locations
- same kind of clear, windless days
- same week of the year
- same time of the day.

To keep tabs on the quail population, the most successful managers use whistle counts outside of the hunting season, during June and October. Counts in June provide an index of whistling males, which gives an idea of how many quail survived the winter. Although males whistle throughout the day, the most consistent measurements occur during the first two hours of daylight.

Fall covey whistle counts, on the other hand, require different tactics and provide different biological information. Fall whistling lasts only minutes each day, and gives an estimate of production and pre-hunting season conditions.

Both methods can help you evaluate your situation and management techniques. The greatest insight will come if you do whistle counts before and after initiating management. Along the way, year-to-year counts will allow you to relate quail numbers to weather, local habitat conditions and other changes on the landscape.

WHISTLE COUNT PROCEDURES

Successful counts require considerable preparation. Before going afield, carefully study habitat maps and photos and decide what area or areas you want to survey. The maximum distance a quail whistle can be heard is about 800 yards when sound is carried by a light breeze. Under most circumstances the furthest distance is about 500 yards, but trees or tall native grasses can substantially reduce the distance. Biologists commonly use the 500-yard hearing distance when choosing listening stations. To ensure that you are not counting the same birds twice, space listening stations at least 1,000 yards apart or stand at the edge of your property where large barriers (such as forests) prevent sound traveling from areas you do not want to sample or recount.

Be sure to permanently mark your listening stations. Because October counts begin before sunrise, mark a post or tree with reflective tape so that it can be located in the dark with a flashlight. If you drive to the station, park far enough away so that the engine cooling noises do not interfere with hearing. Stand at the same point each year so you can track change over time. A compass can be helpful in distinguishing among different quail and locations.

Listen only on clear days when the wind is less than 5 mph. When you are in position, point the compass at the whistling bird, jot down the azimuth, and get ready for another location. If you place this azimuth line on an aerial photo, you'll later be able to identify occupied habitats and locate birds to flush and count.

EVALUATING BREEDING BIRDS

To get an index of birds that survived the winter and are available for breeding, listen for whistling males for 1-2 hours after sunrise during June. Nesting by females is at its peak this month, so males are actively calling. Count the number of individuals you hear. Because quail can whistle for hours, be careful not to recount the same bird. If you listen every year at the same spot, within one week of the same date, and at about the same time, you can track how well birds are surviving winter in relation to your management. To see if your quail are faring better than quail on other lands, compare your population trends to the statewide breeding bird survey, available on the Conservation Department's web site. See page 63.

PRE-SEASON EVALUATION

To provide a measurement of production just prior to hunting season, listen for covey calls during the last three weeks of October. Begin listening 45 minutes before sunrise. Continue until birds whistle or until sunrise if you hear no whistling. Fall coveys usually whistle about 25 minutes before sunrise and for less than 30 seconds. The intensity of whistling in your area will depend on how many quail there are to answer the initial call. Conservation Department research found that not all coveys in an area will whistle, and that the percentage of coveys that whistle increases when there are more coveys to stimulate each other. To better estimate how many coveys are in your listening area, the actual number heard can be corrected. Correction rates are 53 percent when only one covey is heard, 85 percent when two to four coveys whistle, and 94 percent when five or more coveys are heard. For example, if you hear one covey, divide by 0.53 to estimate 1.9 coveys, and if you hear 10 coveys, divide by 0.94 to estimate 10.6 coveys. Check the Department's website for updates on this technique.

Glossary

Bald: Ozark glades that occupy nearly the entire mountaintop.

Conservation Reserve Program (CRP): A voluntary program of the Farm Service Agency, which is available to agricultural producers to help them safeguard environmentally sensitive land. Landowners enrolled in CRP plant long-term, resource-conserving covers to improve the quality of water, control soil erosion, and enhance wildlife habitat. In return, the Farm Service provides them with rental payments and cost-share assistance. Contract duration is between 10 and 15 years.

Contour strip cropping: Crop fields that are farmed following the contour of the land.

Clearcut: Timberland that has recently undergone a complete harvest.

Edge feathering: A strip of land between a field and trees that is maintained in brush and weeds.

Fallow: Land on which the soil has been recently worked, perhaps cropped, then left unattended. Major plants species are annual forbs.

Forbs: Nonwoody broad-leaved plants, including most annual and perennial plants commonly called weeds.

Glade: Rocky, dry slopes, usually facing south or west.

Group cut: Timberland where a small group of trees are cut, but the cleared area is still surrounded by trees.

Habitat: The environment in which the life needs of an organism, population or community are supplied.

Herbaceous cover: Nonwoody plants, such as grasses and forbs.

Idle land: Land that has not been disturbed recently and has a array of naturally occurring plants, including annual forbs, grasses and emerging wood vegetation.

Legumes: Plants that produce a pea or bean-type seed and enrich the soil with nitrogen. Examples include lespedeza, clover, beggarweeds and partridge peas.

Litter: Dead leaves, grass and forbs covering the soil's surface.

Mast: Plant fruit, such as acorns, beechnuts, walnuts and conifer seeds, especially when used as food by animals.

Nonherbaceous plants: Woody plants, including trees, shrubs and vines.

Old fields: Abandoned pasture, hay and crop fields that contain a greater variety of plant types than usually found in fallow land. Plants include grasses, perennial weeds, scattered small trees, brambles and vines.

Savanna: Open woodlands that allow light to reach the ground where many species of grasses and wildflowers grow.

Vegetative succession: The progressive development of vegetation toward its highest ecological expression, the climax; the replacement of one plant community by another, such as grasslands to woody brush to forest.

For help managing quail and developing other conservation practices on your property, contact the following experts. You can also visit the Conservation Department's website at: www.missouriconservation.org.

MISSOURI DEPARTMENT OF CONSERVATION

Private land conservationists can provide advice on a wide variety of land management objectives, including quail and other wildlife management, prairie restoration, stream bank stabilization, hay and grazing systems, livestock watering systems and soil erosion control. At the landowners request, they also can make recommendations on pond, forest, wildlife and natural community management, and can help with wildlife that are a nuisance or causing property damage. These private land conservationists, who have special training in one discipline, call on other Conservation Department, Natural Resource Conservation Service, and University of Missouri Outreach and Extension specialists as the need arises.

Private land conservationists meet with landowners one-on-one, hold workshops and give presentations to farmers' organizations, civic clubs and conservation organizations. They also provide technical support to agricultural education instructors on wildlife projects. See page 63 for the number to call in your area.

NATURAL RESOURCES CONSERVATION SERVICE

The Natural Resources Conservation Service, or NRCS, is a unit of the U.S. Department of Agriculture. NRCS is responsible for the technical aspects of USDA programs, and works closely with the Farm Service Agency in the administration of these programs.

Local NRCS personnel can assist in developing conservation plans that detail the practices necessary to protect your land from erosion, improve water quality and create better fish and wildlife habitat. They also make forage and crop management recommendations, help with the design of terraces, waterways and ponds, and suggest plant species that best meet your resource needs.

Your local NRCS office is listed in the telephone book white pages under "United States Government—Agriculture, Department of—Natural Resources Conservation Service."

Need more information?

To request copies of this booklet and other free publications listed on page 60–61, contact:

Missouri Department of Conservation
P.O. Box 180
Jefferson City, MO 65102-0180
Phone: 573/751-4115, ext. 3237

For a free list of nurseries that carry native seed adapted to Missouri, write to Private Land Services at the above address.

To purchase Department videos, books and other gift shop items, call the Nature Shop at 877-521-8632 from 8 a.m. to 5 p.m. CST, Monday through Friday except holidays. The Nature Shop number is for purchases only. If you have a question about conservation issues, call a number on page 63.

UNIVERSITY OUTREACH AND EXTENSION

University Outreach and Extension, formerly called Missouri Cooperative Extension Service, provides technical assistance on a broad range of agricultural projects. These offices have a wide selection of printed material available on various aspects of agriculture, forestry, horticulture, home economics, wildlife conservation and wildlife damage to property and crops. Your University Outreach and Extension office also will do soil testing and help you interpret the results.

University Outreach and Extension has agricultural advisors stationed at many locations throughout the state. They work individually with farmers or give presentations to groups on agricultural topics.

Your county office is listed in the yellow pages under "Government Offices—County." It often is listed as "University Outreach and Extension, University of Missouri." Web address: outreach.missouri.edu

SOIL & WATER CONSERVATION DISTRICT

The Soil and Water Conservation District, or SWCD, is a local organization under the Soil and Water District Commission of the Missouri Department of Natural Resources. Each district is guided by an elected volunteer board of directors, made up of local landowners. Local district boards usually employ a manager and one or more technicians who assist the Natural Resources Conservation Service field staff.

The districts administer state cost-share conservation programs with assistance from the Department of Natural Resources and NRCS. In conjunction with NRCS, SWCD supports various resource conservation activities; and in many districts, the agency provides conservation education to local schools. Many SWCD offices also participate in cooperative cost-share programs with the Missouri Department of Conservation. Your local SWCD office will usually have the same telephone number as the NRCS office.

QUAIL UNLIMITED

Established in 1981 to battle the problem of dwindling quail and wildlife habitat, Quail Unlimited is a national, nonprofit conservation organization dedicated to the wise management and conservation of America's wild quail as a valuable and renewable resource.

The nationwide network of local chapters work toward preserving the quail sporting heritage for the present and for future generations. These groups raise funds in their communities, then fund local projects that have the greatest impact on quail, dove, upland game birds and other wildlife species. These projects include local habitat restoration, educational projects, upland game bird management, research and youth programs.

QU works with the Conservation Department to promote quail habitat through programs such as the Missouri Quail Habitat Initiative and the MO Quail Academy that provides hand-on experience for high school students.

To find a chapter near you, contact Quail Unlimited National Headquarters at 31 Quail Run, P.O. Box 610, Edgefield, S.C. 29824. Call 803/637-5731, or visit the website at www.qu.org.

REFERENCE BOOKS & OTHER RELATED PUBLICATIONS

"Forest Management for Missouri Landowners"**

Missouri Wildflowers by Edgar Denison*

"Rich Grasslands for Missouri Landowners"**

Steyermark's Flora of Missouri, Vol. I, by George Yatskievych*

Tall Grass Prairie Wildflowers by Doug Ladd

Tallgrass Restoration Handbook for Prairies, Savannas, and Woodlands edited by Stephen Packard and Cornelia F. Mutel

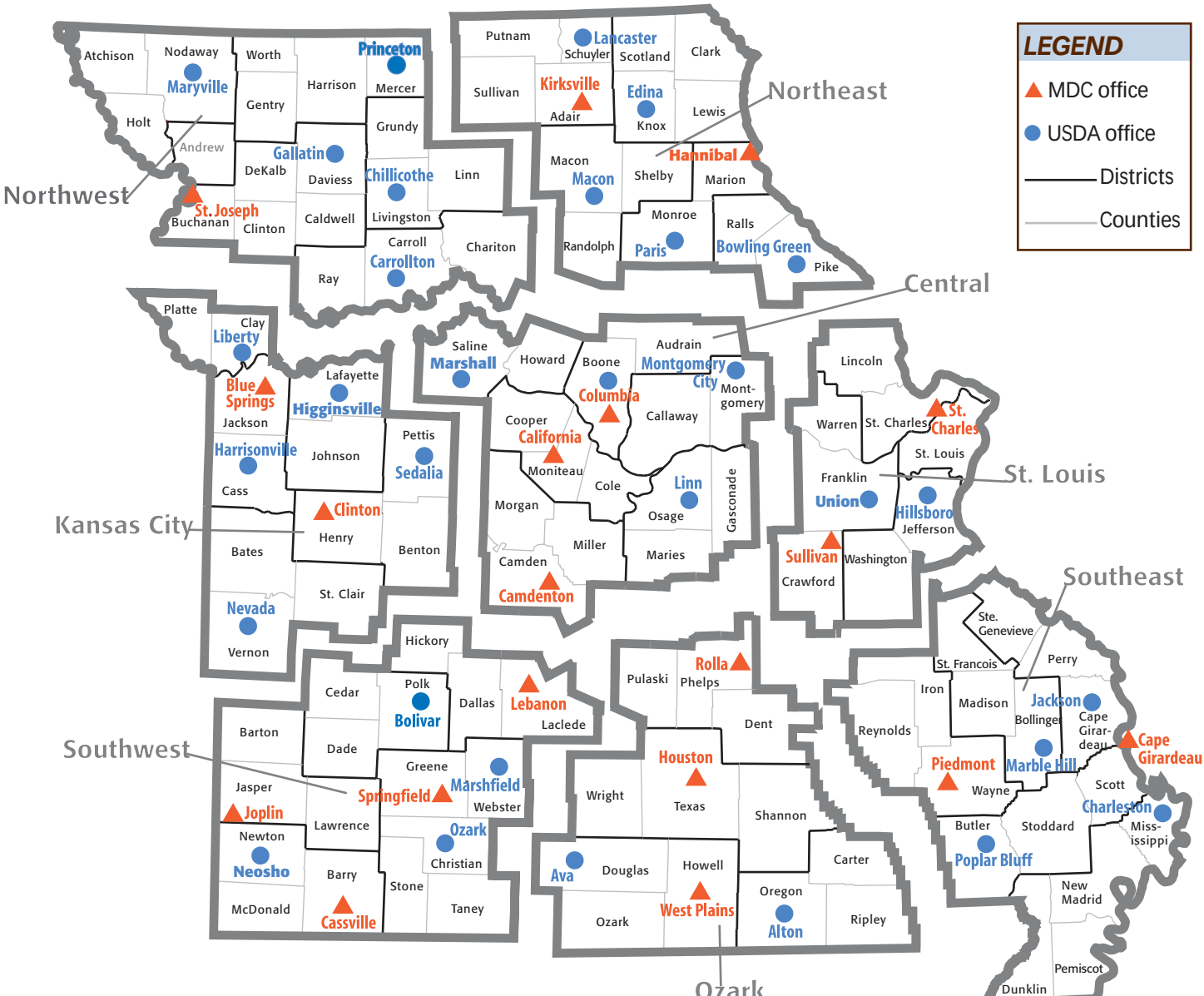
The Prairie Garden by J. Robert Smith with Beatrice S. Smith

Restoring the Tallgrass Prairie by Shirley Shirley

"Wildlife Management for Missouri Landowners"**

* *Can be purchased from the Missouri Department of Conservation. See page 59*

** *Free publication. See page 59.*


LEGEND
MDC office
USDA office
Districts
Counties
Northwest
Northeast
Central
St. Louis
Kansas City
Southeast
Southwest
Ozark
Atchison
Nodaway
Maryville
Worth
Princeton
Mercer
Harrison
Gentry
Holt
Andrew
Gallatin
DeKalb
Daviess
Grundy
Chillicothe
Linn
Livingston
Buchanan
St. Joseph
Clinton
Caldwell
Carroll
Carrollton
Chariton
Ray
Putnam
Lancaster
Schuyler
Scotland
Clark
Sullivan
Kirksville
Adair
Edina
Knox
Lewis
Macon
Shelby
Marion
Hannibal
Monroe
Randolph
Paris
Ralls
Bowling Green
Pike
Platte
Clay
Liberty
Saline
Marshall
Howard
Boone
Columbia
Audrain
Montgomery City
Mont-gomery
Callaway
Cooper
California
Moniteau
Morgan
Cole
Osage
Gascon-ade
Miller
Maries
Camden
Camdenton
Lincoln
Warren
St. Charles
St. Louis
Franklin
Union
Hillsboro
Jefferson
Sullivan
Crawford
Washington
Blue Springs
Jackson
Lafayette
Higginsville
Harrisonville
Cass
Johnson
Pettis
Sedalia
Clinton
Henry
Bates
Benton
St. Clair
Nevada
Vernon
Hickory
Polk
Bolivar
Cedar
Dallas
Lebanon
Laclede
Barton
Dade
Greene
Springfield
Marshfield
Webster
Jasper
Joplin
Newton
Neosho
Lawrence
Ozark
Christian
Barry
Stone
Taney
McDonald
Cassville
Pulaski
Rolla
Phelps
Dent
Houston
Texas
Wright
Shannon
Ava
Douglas
Howell
West Plains
Oregon
Alton
Carter
Ripley
Ozark
Ste. Genevieve
St. Francois
Perry
Iron
Madison
Jackson
Bollinger
Cape Girar-deau
Cape Girardeau
Reynolds
Piedmont
Wayne
Marble Hill
Scott
Charleston
Miss-issippi
Butler
Stoddard
Poplar Bluff
New Madrid
Pemiscot
Dunklin

The Conservation Department's staff is available to help you develop and manage quail habitat on your property. For the name of a contact person, call the Conservation Department or USDA office in your district, which are listed below. On the internet, go to Private Land Assistance on the Missouri Department of Conservation web site: http://www.missouriconservation.org

Administrative Office

Jefferson City: 573/751-4115

Northwest

▲ St. Joseph: 816/271-3100
● Carrollton: 660/542-3361
● Chillicothe: 660/646-6220
● Gallatin: 660/663-3703
● Maryville: 660/582-7125
● Princeton: 660/748-3857
● St. Joseph: 816/364-3662

Northeast

▲ Kirksville: 660/785-2424
▲ Hannibal: 573/248-2530
● Bowling Green: 573/324-3201
● Edina: 660/397-2223
● Lancaster: 660/457-3716
● Macon: 660/385-2616
● Paris: 660/327-4117

St. Louis

▲ St. Charles: 636/300-1953
▲ Sullivan: 573/468-3335
● Hillsboro: 636/789-2441
● Union: 636/583-2303

Southeast

▲ Cape Girardeau: 573/290-5730
▲ Piedmont: 573/223-4525
● Charleston: 573/649-9930
● Jackson: 573/243-1467
● Marble Hill: 573/238-2671
● Poplar Bluff: 573/785-6160

Ozark

▲ West Plains: 417-256-7161
▲ Houston: 417/967-3385
▲ Rolla: 573/368-2225
● Alton: 417-778-6610
● Ava: 417/683-4816

Southwest

▲ Springfield: 417/895-6880
▲ Cassville: 417/847-5949
▲ Joplin: 417/629-3423
▲ Neosho: 417/451-4158
▲ Lebanon: 417/532-7612
● Bolivar: 417/326-5993
● Marshfield: 417/468-4176
● Ozark: 417/581-2719

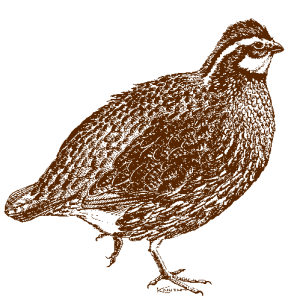
Kansas City

▲ Blue Springs: 816/655-6250
▲ Clinton: 660/885-6981
● Liberty: 816/781-5580
● Harrisonville: 816/884-3391
● Higginsville: 660/584-8732
● Nevada: 417/667-8137
● Sedalia: 660/826-3354

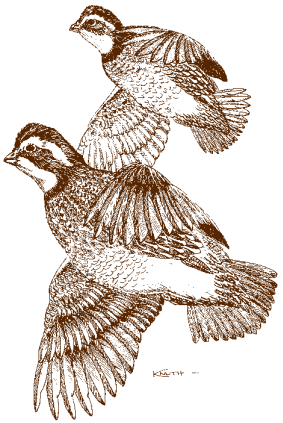
Central

▲ Columbia: 573/884-6861
▲ California: 573/796-0286
▲ Camdenton: 573/346-2210
● Columbia: 573/875-5540
● Linn: 573/897-3797
● Marshall: 660/886-5773
● Montgomery City: 573/564-3715

Notes

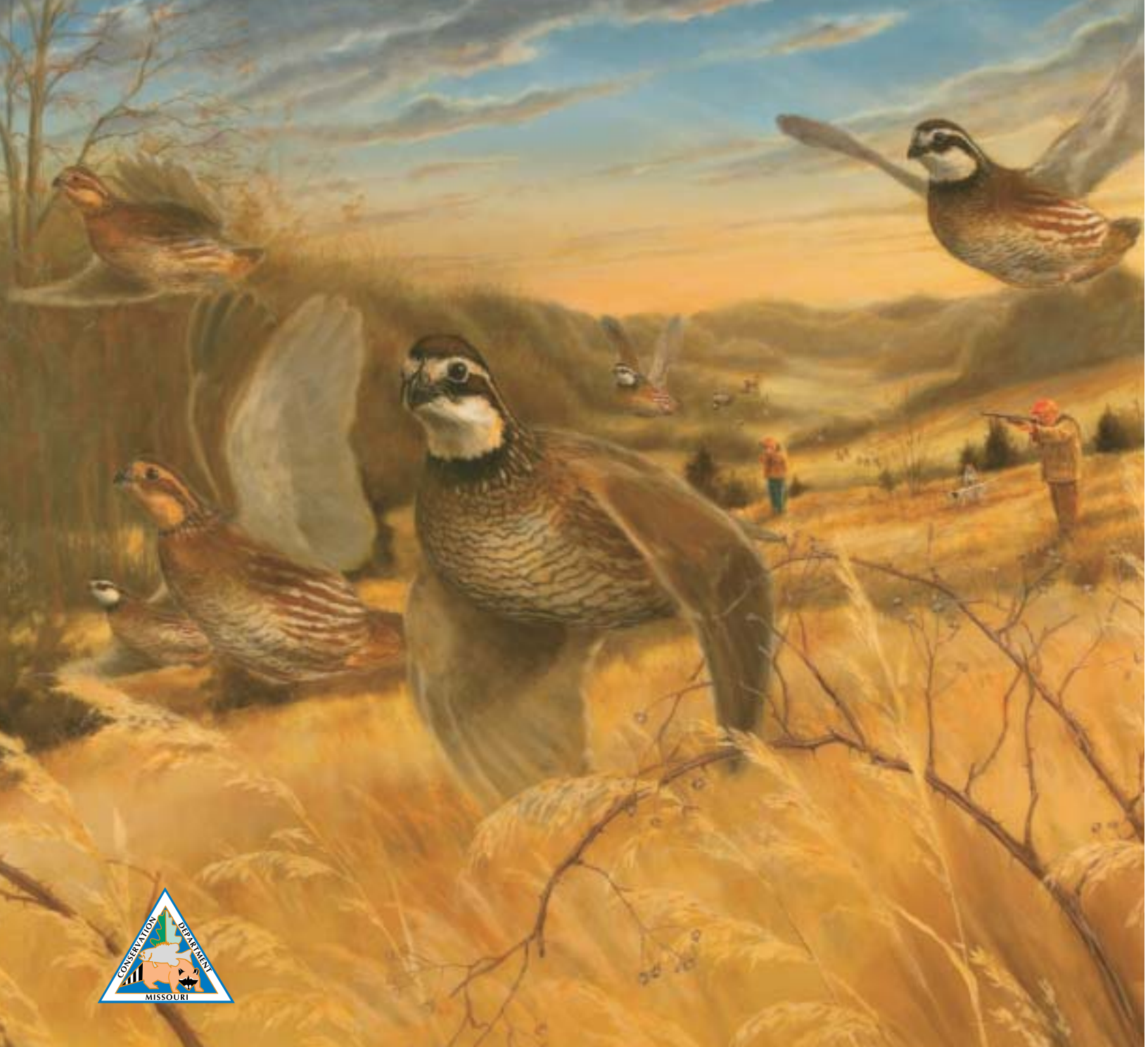


Notes



Notes

Notes


CONSERVATION DEPARTMENT
MISSOURI